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# THE UNITED STATES OF AMERICA

**TO ALL TO WHOM THESE PRESENTS SHALL COME:**

UNITED STATES DEPARTMENT OF COMMERCE  
United States Patent and Trademark Office

November 12, 2003

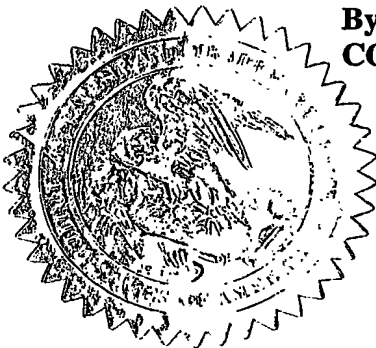
**THIS IS TO CERTIFY THAT ANNEXED HERETO IS A TRUE COPY FROM THE RECORDS OF THE UNITED STATES PATENT AND TRADEMARK OFFICE OF THOSE PAPERS OF THE BELOW IDENTIFIED PATENT APPLICATION THAT MET THE REQUIREMENTS TO BE GRANTED A FILING DATE.**

**APPLICATION NUMBER: 60/414,969**

**FILING DATE: September 30, 2002**

**RELATED PCT APPLICATION NUMBER: PCT/US03/30843**

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09/30/02  
31132 U.S. PTO

Attorney Docket: 3DM A-350

Patent

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of: Miguel A. Linares, et al.

Serial No.: Filed Herewith

Filing Date: September 30, 2002

Title: "PRODUCTION METHOD AND APPARATUS FOR FORMING PLASTIC MOLDED ARTICLES"

Box Provisional Patent Application  
Assistant Commissioner for Patents  
Washington DC 20231

31040 U.S. PTO  
60/414969

**TRANSMITTAL LETTER**

Dear Sir:

Enclosed herewith for filing in the above-identified provisional patent application, please find the following documents:

1. Transmittal Letter (original & copy) - 2 Pgs.;
2. Provisional Application For Patent Cover Sheet Small Entity (original & copy) - 6 Pgs.;
3. Application For Letters Patent (Specification) - 9 Pgs.;
4. Informal Drawings - 13 Pgs.; and
5. Return Receipt Postcard

EXPRESS MAIL CERTIFICATE

"Express Mail" Label Number: E0290311551US

Date of Deposit September 30, 2002

I hereby certify that the following attached papers and/or fee are being deposited with the United States Postal Service "Express Mail Post Office to Addressee" pursuant to 37 CFR 1.10, with sufficient postage, on the date indicated above and is addressed to "Box Provisional Patent Application, Assistant Commissioner for Patents, Washington, DC 20231"

Nancy L. Craft

Name

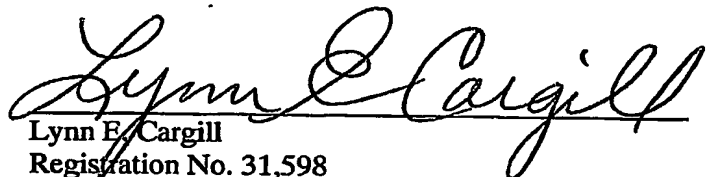
*Nancy L. Craft*  
Signature

Transmittal Letter  
September 30-, 2002  
Page 2

The Commissioner is authorized to charge the \$80.00 filing fee and any other fee and/or credit any overpayment associated with this communication to Deposit Account No. 03-0682. A duplicate copy of this Transmittal is enclosed.

Respectfully submitted,

CARGILL & ASSOCIATES



Lynn E. Cargill  
Registration No. 31,598  
56 Macomb Place  
Mt. Clemens MI 48043-5636  
(586) 465-6600

Date: September 30, 2002

C33DMA-19A1, rev 07/30/02

Please type a plus sign (+) inside this




Docket Number

3DM A-350

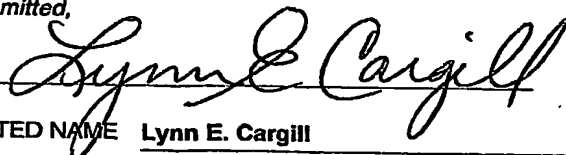
# PROVISIONAL APPLICATION FOR PATENT COVER SHEET (Small Entity)

This is a request for filing a PROVISIONAL APPLICATION FOR PATENT under 37 CFR 1.53 (c).

INVENTOR(S)/APPLICANT(S)					
Given Name (first and middle [if any])		Family Name or Surname		Residence (City and either State or Foreign Country)	
Miguel A. Panfilo M.		Linares DiNello		Bloomfield Hills, Michigan Clinton Township, Michigan	
<input type="checkbox"/> Additional inventors are being named on page 2 attached hereto					
TITLE OF THE INVENTION (280 characters max)					
"PRODUCTION METHOD AND APPARATUS FOR FORMING PLASTIC MOLDED ARTICLES"					
Direct all correspondence to: CORRESPONDENCE ADDRESS					
<input checked="" type="checkbox"/> Customer Number		25686		 Patent Customer Number 25686	
<input type="checkbox"/> Firm or Individual Name		PATENT TRADEMARK OFFICE			
Address					
Address					
City		State		ZIP	
Country		Telephone		Fax	
ENCLOSED APPLICATION PARTS (check all that apply)					
<input checked="" type="checkbox"/> Specification	Number of Pages	9	<input checked="" type="checkbox"/> Small Entity Statement	- See Page 5	
<input checked="" type="checkbox"/> Drawing(s)	Number of Sheets	13	<input type="checkbox"/> Other (specify)		
METHOD OF PAYMENT OF FILING FEES FOR THIS PROVISIONAL APPLICATION FOR PATENT (check one)					
<input type="checkbox"/> A check or money order is enclosed to cover the filing fees				FILING FEE AMOUNT (\$)	
<input checked="" type="checkbox"/> The Commissioner is hereby authorized to charge filing fees or credit any overpayment to Deposit Account Number:		03-0682		\$80.00	
The invention was made by an agency of the United States Government or under a contract with an agency of the United States Government.					
<input checked="" type="checkbox"/> No					
<input type="checkbox"/> Yes, the name of the U S Government agency and the Government contract number are					

Respectfully submitted,

SIGNATURE



Date 30 Sept 2002 (30.09.02)

TYPED or PRINTED NAME Lynn E. Cargill

REGISTRATION NO. 31,598  
(if appropriate)

TELEPHONE (586) 465-6600

**USE ONLY FOR FILING A PROVISIONAL APPLICATION FOR PATENT**

SEND TO: Box Provisional Application, Assistant Commissioner for Patents, Washington, DC 20231

11040 U.S. PRO

60/414969

11040 U.S. PRO

Attorney's Docket No. 3DM A-350**PATENT****IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**In re application of: Miguel A. Linares, et al.For: "PRODUCTION METHOD AND APPARATUS FOR FORMING PLASTIC MOLDED ARTICLES"Box Provisional Patent Application  
Assistant Commissioner for Patents  
Washington, D.C. 20231**COVER SHEET FOR FILING PROVISIONAL APPLICATION**  
(37 C.F.R. § 1.51(2)(i))**WARNING:** "A provisional application must also include a cover sheet identifying the application as a provisional application. Otherwise, the application will be treated as an application filed under § 1.53(b)(1)." 37 C.F.R. § 1.53(b)(2)(i).**NOTE:** "A complete provisional application does not require claims since no examination on the merits will be given to a provisional application. However, provisional applications may be filed with one or more claims as part of the application. Nevertheless, no additional claim fee or multiple dependent claims fee will be required in a provisional application." Notice of December 5, 1994, 59 FR 63951, at 63953.  
"Any claim filed with a provisional application will, of course, be considered part of the original provisional application disclosure." Notice of April 14, 1995, 60 Fed. Reg. 20,195, at 20,209.**NOTE:** "A provisional application shall not be entitled to the right of priority under § 1.55 or 35 U.S.C. 119 or 365(a) or to the benefit of an earlier filing date under § 1.78 or 35 U.S.C. 120, 121 or 365(c) of any other application." 37 C.F.R. § 1.53(b)(2)(iii).**NOTE:** "No information disclosure statement may be filed in a provisional application." 37 C.F.R. § 1.51(2)(b).  
"Any information disclosure statements filed in a provisional application would either be returned or disposed of at the convenience of the Office." Notice of December 5, 1994, 59 FR 63591, at 63594.**NOTE:** "No amendment other than to make the provisional application comply with all applicable regulations, may be made to the provisional application after the filing date of the provisional application." 37 C.F.R. § 1.53(b)(2).**CERTIFICATION UNDER 37 CFR 1.10**I hereby certify that this correspondence and the documents referred to as attached therein are being deposited with the United States Postal Service on September 30, 2002 (date), in an envelope as "EXPRESS MAIL POST OFFICE TO ADDRESSEE" service under 37 C.F.R. 1.10, Mailing Label Number E029031155108 addressed to the: Assistant Commissioner for Patents, Washington, D.C. 20231.

Signature

Nancy L. Craft

(type or print name of person certifying)

**NOTE:** Each paper or fee filed by "Express Mail" must have the number of the "Express Mail" mailing label placed thereon prior to mailing. (37 C.F.R. 1.10(b))**WARNING:** Certificate of mailing (first class) or facsimile transmission procedures of 37 CFR 1.8(a) cannot be used to obtain a date of mailing or transmission for this correspondence. 37 C.F.R. 1.8(a)(i)(A)

**WARNING:** A provisional application may be abandoned by operation of 35 U.S.C. 111(b)(5) on a Saturday, Sunday, or Federal holiday within the District of Columbia, in which case, a nonprovisional application claiming benefit of the provisional application under 35 U.S.C. 119(e) must be filed no later than the preceding day that is not a Saturday, Sunday, or Federal holiday within the District of Columbia. Notice of April 14, 1995, 60 Fed. Reg. 20,195 at 20,202.

1. The accompanying application is a provisional application. (37 C.F.R. § 1.51(a)(2)(i)(A))

2. The name(s) of the inventor(s) is/are (37 C.F.R. § 1.51(a)(2)(i)(B)):

**NOTE:** While the name or names of the inventors are required in order to accord a provisional application a filing date, a provisional application is not required to be signed by the inventor or the assignee. No oath or declaration is required. Presumably, most provisional applications will be filed by a registered practitioner without a power of attorney being filed. Notice of December 5, 1994, 59 FR 63591, at 63594.

**NOTE:** "The naming of inventors for obtaining a filing date for a provisional application is the same as for other applications. A provisional application filed with the inventors identified as 'Jones et al.' will not be accorded a filing date earlier than the date upon which the name of each inventor is supplied unless a petition with the fee set forth in § 1.17(i) is filed which sets forth the reasons the delay in supplying the names should be excused. Administrative oversight is an acceptable reason. It should be noted that for a 35 U.S.C. 111(a) application to be entitled to claim the benefit of the filing date of a provisional application the 35 U.S.C. 111(a) application must have at least one inventor in common with the provisional application." Notice of April 14, 1995, 60 Fed. Reg. 20,195, at 20,209.

The term "invention" is typically used to refer to subject matter which applicant is claiming in his/her application. Because claims are not required in a provisional application, it would not be appropriate to reference joint inventors as those who have made a contribution to the "invention" disclosed in the provisional application. If the "invention" has not been determined in the provisional application because no claims have been presented, then the name(s) of those person(s) who have made a contribution to the subject matter disclosed in the provisional application should be submitted. Section 1.45(c) states that "if multiple inventors are named in a provisional application, each named inventor must have made a contribution, individually or jointly, to the subject matter disclosed in the provisional application." All that § 1.45(c) requires is that if someone is named as an inventor, that person must have made a contribution to the subject matter disclosed in the provisional application. When applicant has determined what the invention is by the filing of the 35 U.S.C. 111(a) application, that is the time when the correct inventors must be named. The 35 U.S.C. 111(a) application must have an inventor in common with the provisional application in order for the 35 U.S.C. 111(a) application to be entitled to claim the benefit of the provisional application under 35 U.S.C. 119(e). Notice of April 14, 1995, 60 Fed. Reg. 20,195, at 20,208.

"If all the names of the actual inventor or inventors are not supplied when the specification and any required drawings are filed, the provisional application will not be given a filing date earlier than the date upon which the names are supplied unless a petition, with the fee set forth in § 1.17(q), is filed, which sets forth that the reasons for the delay in supplying the names should be excused." 37 C.F.R. § 1.53(b)(2).

1.	<u>Miguel</u>	<u>A.</u>	<u>Linares</u>
	GIVEN NAME	MIDDLE INITIAL OR NAME	FAMILY (OR LAST) NAME
2.	<u>Panfilo</u>	<u>M.</u>	<u>DiNello</u>
	GIVEN NAME	MIDDLE INITIAL OR NAME	FAMILY (OR LAST) NAME
3.	<u></u>	<u></u>	<u></u>
	GIVEN NAME	MIDDLE INITIAL OR NAME	FAMILY (OR LAST) NAME

3. Address(es) of the inventor(s), as numbered above (37 C.F.R. § 1.51(a)(2)(i)(C)):
1. 2769 Mackintosh Lane, Bloomfield Hills, Michigan 48302
  2. 38623 Wingate, Clinton Township, Michigan 48038
  3. \_\_\_\_\_
4. The title of the invention is (37 C.F.R. § 1.51(a)(2)(i)(D)):  
"PRODUCTION METHOD AND APPARATUS FOR FORMING PLASTIC MOLDED  
ARTICLES"
5. The name, registration, and telephone number of the attorney (if applicable) is (37 C.F.R. § 1.51(a)(2)(i)(E)):
- Name of attorney: Lynn E. Cargill  
Reg. No. 31,598 Tel. ( 586 ) 465-6600
- (complete the following, if applicable)
- ☐ A power of attorney accompanies this cover sheet.
6. The docket number used to identify this application is (37 C.F.R. § 1.51(a)(2)(i)(F)):  
Docket No.: 3DM A-350
7. The correspondence address for this application is (37 C.F.R. § 1.51(a)(2)(i)(G)):  
Lynn E. Cargill  
Cargill & Associates, 56 Macomb Place, Mt. Clemens MI 48043-5636
8. Statement as to whether invention was made by an agency of the U.S. Government or under contract with an agency of the U.S. Government.  
(37 C.F.R. § 1.51(a)(2)(i)(H))

This invention was made by an agency of the United States Government, or under contract with an agency of the United States Government.

☒ No.

☐ Yes.

The name of the U.S. Government agency and the Government contract number are: \_\_\_\_\_

**9. Identification of documents accompanying this cover sheet:**

**A. Documents required by 37 C.F.R. §§ (a)(2)(ii)–(iii):**

**Specification:**

No. of pages 9

**Drawings:**

No. of sheets 13

**B. Additional documents:**

☐ **Claims:**

No. of claims \_\_\_\_\_

**Note:** A complete provisional application does not require claims. 37 C.F.R. § 1.51(a)(2).

☐ Power of attorney

☒ Small entity statement - see Nos. 10 and 11 below

☐ Assignment

☐ Other

**NOTE:** *Provisional applications may be filed in a language other than English as set forth in existing § 1.52(d). However, an English language translation is necessary for security screening purposes. Therefore, the PTO will require the English language translation and payment of the fee mandated in § 1.52(d) in the provisional application. Failure to timely submit the translation in response to a PTO requirement will result in the abandonment of the provisional application. If a 35 U.S.C. 111(a) application is filed without providing the English language translation in the provisional application, the English language translation will be required to be supplied in every 34 U.S.C. 111(a) application claiming priority of the non-English language provisional application. Notice of April 14, 1995, 60 Fed. Reg. 20,195, at 20,209.*

## 10. Fee

The filing fee for this provisional application, as set in 37 C.F.R. § 1.16(k), is \$150.00, for other than a small entity, and \$75.00, for a small entity.

☒ Applicant is a small entity.

**NOTE:** *"A verified statement in compliance with existing § 1.27 is required to be filed in each provisional application in which it is desired to pay reduced fees." Notice of April 14, 1995, 60 Fed. Reg. 20,195, at 20,197.*

## 11. Small entity statement

☒ ~~Applicant(s) is/are a small entity.~~ Applicant(s) is/are a small entity.

**12. Fee payment being made at this time**

☒ Not enclosed

☐ No filing fee is to be paid at this time. (This and the surcharge required by 37 C.F.R. § 1.16(l) can be paid subsequently).

☐ **Enclosed**

**Total fee enclosed**      \$ \_\_\_\_\_



## 13. Method of fee payment

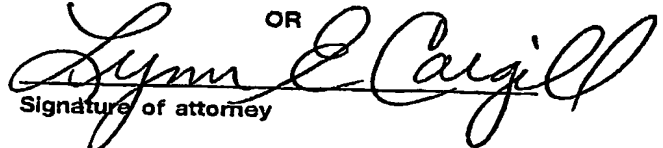
☐ Check in the amount of \$ \_\_\_\_\_☒ Charge Account No. 03-0682, in the amount of \$ 80.00  
A duplicate of this Cover Sheet is attached.Please charge Account No. 03-0682 for any fee deficiency.

Date: \_\_\_\_\_

Tel.: (     )

Date: 30 Sept 2002Reg. No.: 31,598

Tel.: ( 586 ) 465-6600

\_\_\_\_\_  
Signature of submitterOR  
  
\_\_\_\_\_  
Signature of attorneyLynn E. Cargill

(type or print name of attorney)

56 Macomb Place\_\_\_\_\_  
P.O. AddressMt. Clemens MI 48043-5636  
\_\_\_\_\_

*APPLICATION FOR LETTERS PATENT*

for

*PRODUCTION METHOD  
AND APPARATUS FOR FORMING  
PLASTIC MOLDED ARTICLES*

by

Miguel A. Linares  
2769 Mackintosh Lane  
Bloomfield Hills MI 48302

and

Panfilo M. DiNello  
38623 Wingate  
Clinton Township MI 48038

both Citizens of the United States of America

# **PRODUCTION METHOD AND APPARATUS FOR FORMING PLASTIC MOLDED ARTICLES**

5

## **CROSS REFERENCES TO RELATED APPLICATIONS**

This application claims the benefit of U.S. Provisional Application No. 60/270,321  
10 filed on February 5, 2001, U.S. Provisional Application No. 60/300,874 filed on June 25, 2001, U.S.  
Provisional Application No. 60/346,336 filed on January 7, 2002, and International Application No.  
PCT/US02/03298 filed February 5, 2002, all of which are to be incorporated herein by reference.

15

## **TECHNICAL FIELD**

This invention relates to methods and apparatus for molding plastic articles, and  
more particularly relates to a method for molding plastic into articles from particulate plastic  
material.

20

## **BACKGROUND OF THE INVENTION**

Since the introduction of plastics in the 1940's after World War II, engineers have  
25 been utilizing plastic to make any number of different articles. The plastic industry started with  
an injection molding machine and method, and has since been advanced into blow-molding,  
roto-molding, compression-molding, and other means of making plastic articles. Making a mold  
for an injection molding machine, which is the most common form of forming plastic, is  
basically a series of steps which include the manufacture of an aluminum or Kirksite mold in  
30 order to produce proto-type plastic parts. These molds generally can produce a number of plastic

articles on the order of from approximately 100 parts to about 2 to 3 thousands parts, depending on what the tolerances are for the molded articles themselves. If the molded articles have a lot of sharp corners and high tolerance components, the aluminum or Kirksite mold will quickly degrade in quality and maintain its tolerances due to the fact that high pressure is utilized to force melted plastic particles into the mold with such pressure that it will force the plastic into all the nooks and crannies of the mold, thereby forming a complex part. As injection molding is the most common of the plastic forming techniques, it is well known to be the least expensive means for forming large numbers of such plastic articles.

Although injection molding is the least expensive process, this is only the case if the plastic articles being formed are being made in large volumes. The cost of the injection mold must be amortized over the cost of all of the plastic parts. For instance, if a mold costs \$150,000 U.S. dollars, and it is planned to form 600,000 parts, then \$150,000 or one-quarter, of the costs of each of the 600,000 parts must be attributed to the cost of the mold. Therefore, it has always been an expensive proposition to run a small number of plastic parts with an expensive injection mold. The cost of the mold has basically raised the cost of the plastic parts to a point where it is not feasible.

Other methods of forming plastic have their advantages and disadvantages as well. Some of them do not produce parts that have smooth surfaces on both sides, some of them produce articles utilizing even more expensive materials and producing parts that will crack and stress, while other methods may produce one-sided articles, which may or may not be suitable for certain production items.

Previous methods have formed plastic articles that have modulus strengths which are limited by the modulus strengths of the plastic itself. A steel article has a modulus strength on the order of a 30 modulus. Other materials have modulus strengths generally therebetween. Prior art methods have not been able to strengthen the modulus strength of certain plastic articles, with the exception of the inclusion of various chopped fibers and the like. In addition, load bearing structural elements have been produced for large, self-supporting panels having a high weight to strength ratio for bridge components, airplane decks, and the like. These

components have formed roof panels and the like although there are certain drawbacks which prevent it from being used in the automotive or aircraft industries. These components, however, generally have been produced with a poor surface finish, and will not provide the type of detail which may be necessary for many applications.

5

In addition, prior art methods have been utilized to incorporate a "sandwiched" form, including a foamed polyurethane core, which may be in the form of a foam sponge, or it may be a foamed core which produces gaseous substances during the curing, in order to increase the volume of the foamed core. Certain reinforcing fibers may also be incorporated in an attempt to increase the strength of the plastic.

10

### DETAILED DESCRIPTION OF THE INVENTION

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In accordance with the objects and advantages being sought hereinabove, the present invention discloses a production line method and apparatus for forming plastic molded articles utilizing heated molds and particulate thermoplastic materials. The present method will yield a double-skinned, foamed center plastic article, which may or may not include various reinforcements within the foamed layer. In that regard, there is shown a schematic view of the apparatus for the production line as seen in FIG. 1. A plastic forming production line as shown in FIG. 1 is generally denoted by the numeral 10, and incorporates the use of a first female mold and a second male mold, 12 and 14, respectively. The female and male mold sections 12 and 14 are shown in contact with mold heaters 17 which utilize propane from propane tank 17 in order to heat the mold sections. After the molds 12 and 14 are heated, a particulate plastic material 18 is dropped from above and distributed from a hopper 20 into the cavities of the molds 12 and 14. The plastic melts and forms a skin on the molds.

20

25

In the current embodiment, hopper 20 has a large supply of the particulate plastic material 18, which is preferably a powder, but may also be pellets, resin or any other type of dry particulate material. The powdered materials are distributed via distributor tubes 22 onto the top of the male and female molds 12 and 14. As the molds 12 and 14 have been preheated by heater

30

16 to a temperature above the melting temperature of the particulate material 18, once the powdered material is distributed through tubes 22 into the molds 12 and 14, the particulate material 18 is allowed to sit in the mold in order to melt against the heated mold to form the individual skins.

5

The preferred material for use in this application includes polyurethane thermoplastic, available from Equistar Corporation in the United States, which is readily available throughout the continental United States. Needless to say, any particulate material which is a thermoplastic material that can be melted, would be suitable for this application.

10 Therefore, the list of appropriate materials would include polyethylene, polypropylene, nylons, and all the other thermoplastic materials known to one of ordinary skill in the art. Once the powder 18 is sitting in the molds 12 and 14, a skin forms of the melted and fused plastic, while the upper most portion of powder 18 (as it sits in the mold) will remain in its particulate form, and must be dumped after the appropriate thickness of the skin has been achieved. In our

15 preferred embodiments, the skin shall be manufactured to a thickness of between about 0.5mm and about 5mm. Various applications will require various thicknesses of the skin. It has been found that the particulate material, when it is in the powdered form, having a mesh size of slightly larger than talc powder, has a preferred residence time of approximately one minute per millimeter of thickness of skin. In other words, a full load of powdered material 18 is dumped

20 into molds 12 and 14, after they have been heated to approximately between about 350°F to 450°F, and for every minute that the powder remains in contact with the heated mold, the skin becomes one millimeter thicker. For instance, our preferred thickness for automotive applications is approximately 3mm thick. Therefore, the powdered material is allowed to stay in contact with the heated mold for about three minutes. Of course, the form of the powder affects

25 the length of residency time, where a courser powder would require a longer residence time in order to melt it against the mold to form a skin.

The heaters 16 will be more fully described hereinbelow, as they are referred to by the inventors as a "heater glove" and the molds 12 and 14 are placed in close proximity to the

30 heater glove. The heater glove will heat the molds, which are preferably made of aluminum or an efficiently heat conductive material, to an even temperature of around 350°F to 450°F in order

to melt the polyurethane plastic which is purchased from Equistar Corporation. Therefore, the preferred embodiment utilizes an all aluminum mold, which has been CNC ground to the appropriate configuration, and that mold is heated by flame to an optimum temperature of about 415°F, and is then contacted with a finely powdered polyurethane thermoplastic material, such as  
5 that purchased from Equistar Corporation.

Once the desired skin thickness has been achieved, the molds 12 and 14 need to be emptied to prevent further skin formation. In order to prevent further skin formation, the molds must be tipped over so that the excess powder can be tipped out of the mold and is  
10 collected in a lower hopper 26, which is called the particulate return hopper 26. The molds are tipped inward to empty the excess particulate material into the return hopper via turning axis 24. The mold heater is attached to a pivoting, tipping support 28, and rotates about turning axis 24 in order to dump the excess powder into the hopper 26. Once the tipping mechanism has been finished, the mold transfer cart 30, to which all of the above equipment has been mounted,  
15 includes wheels 32 for transporting the transfer cart from station to station. Once the operation has been finished at the first station, the mold transfer cart is then rolled to a second position underneath the foam station.

At this time, reinforcements may be added to the mold prior to the distribution of  
20 foam through its distributor tubes into the molds. The foam powder distributor mechanism is identical to the surface powder distribution mechanism described hereinabove with reference to FIG. 1. Reinforcements suitable to be put into the mold may include nearly anything, but are preferably pieces of fiberglass cloth, Kevlar cloth, steel mesh, steel perforated sheets, or any other thing which is porous which will allow the foam to foam up, in and around, and  
25 encapsulate the reinforcement within the mold.

Looking now to FIG. 2, there is shown the tipping occurring at the foam station to remove the excess foam powder. This foam powder operation is a similar operation to that of the surface powder station. Once the excess foam powder has been dumped from the molds, the two  
30 molds are held together and clamped to form a cavity into which the foam can expand into. The foam is a polyurethane material available from Equistar Corporation, and is sold under their

proprietary materials group. Again, the excess foam material powder is tipped out of the molds into the return hopper, similar to the particulate return hopper 26 with regards to the surface transfer station, and the excess is vacuumed back upwards to the distributor hopper 20.

5           The two molds are then held together to allow the heat from the molds to activate the foamable polyurethane particulate material such that it foams up into the cavity created by the first and second molds 12 and 14, respectively. Any foamable material may be suitable for this application, and it may also be applied as a liquid in addition to the powdered or particulate foam material which is used in the preferred embodiment of the present invention. For obvious  
10 reasons, distribution of a liquid foamable material would be different than the above-described hopper/dumping method.

          A light-clamping pressure is all that is required to hold the two molds together to maintain a minimum amount of flashing and to evenly distribute bubbles generated in the  
15 foaming procedure throughout, without delaminating the two skins from the foamed material. In the event that a liquid foamable material is to be used, the molds may be held in a horizontal orientation, such that the foamable material may be spread into the bottom mold, while a top mold can be maneuvered into position on top of the bottom mold, and allow the foam to expand into position. Generally, the foaming operation takes anywhere from about one-half minute to  
20 about twenty minutes for full expansion of the foam, depending on the foaming product which is utilized. Furthermore, the foaming action is also dependent on the reinforcements which are included within the mold prior to the mold being held together. The reinforcements become encapsulated by the foam, and become an integral part of the foamed article, once the plastic has cooled and set into a solid material.

25           Looking now to FIG. 3, the mold is shown as having been hoisted up by a chain, and has been transferred to a location above the cooling station, which includes the spraying of water from the city water supply onto the outsides of the mold in order to cool the mold and the contents. As can be seen in FIG. 3, the nozzles in the oval-shaped tub are spaced so as to more  
30 evenly distribute the water against the surface of the mold. The mold is lowered into the oval-shaped cooling station, and the water is pressurized out of the nozzles against the outside of the



mold, and the mold is cooled for a period of anywhere from about 5 minutes to about 90 minutes. Thereafter, the mold halves are opened and the foamed article is released.

Looking next to FIG. 4, there is shown a photograph of the heating glove  
5 described hereinabove with reference to FIGS. 1-3 for heating the molds. The heater glove of FIG. 4 illustrates the heating baffle which is helpful in maintaining a flame when the heater glove is being tipped back and forth. In order to keep heat on the mold while the powder is being tipped out of it, a flame-out-proof design was needed. The baffle keeps the flame lit even during the tipping procedure. The heater glove is shown with a baffle and distribution means,  
10 along with exhaust tubes in order to remove the excess heated air.

Once the heater glove is covered with the mold, as shown in FIG. 5, little red arms are shown holding the side of the mold against the heater glove box. As can be seen, the heater glove box is mounted on an angled piece of steel attached to an axis below. As the axis  
15 turns, the excess powder will be tipped out of the mold. In FIG. 5, the mold is shown without the powder therein, in order to show details of the mold, the axis, and its position.

FIGS. 6 and 7 show the bottom side of the hopper as shown in FIGS. 1-3, and hopper 20 is shown with its distribution arms 22 extending downwardly therefrom. The shutoff  
20 valve is shown in the open position, whereas if the flat gray portion of the shutoff valve is shoved over the distributor tubes, the flow is cut off. However, FIGS. 6 and 7 illustrate the shutoff valve in the open position, such that the material from in the hopper held above the mold will flow downwardly by gravity into the mold. Pre-measured amounts of powder are put into the hopper so that when there is a sufficient amount of powder and the mold, the hopper will  
25 most generally be empty.

Looking next to FIGS. 8 and 9, there is shown the preferred clamping arms which hold the mold to the heater box below. In the preferred embodiment, the clamping arms are hydraulically operated, or may be operated pneumatically for rapid response. FIG. 9 is a close-  
30 up of the clamping arm, while FIG. 8 shows the clamping arm in its working environment.

FIG. 10 shows the tipping mechanism, or trunion, and shows the temperature dial on the side of the heater glove box. The trunion design will be used to rotate about the axis in order to flip so that the mold tips excess powder backward into the center of the transfer station and into the reservoir hopper which is located below. The powdered material from the reservoir  
5 hopper may be vacuumed back up into the upper most hopper in order to recharge the surface and foam hoppers 20.

The water cooling station of this production line includes a multitude of water nozzles for even spraying of cool water onto the sides of the mold (not shown here) in order to  
10 cool off the mold. Once the mold has been lifted from the foam powder station, it is inserted between all of these nozzles from above and the nozzles are turned on for time periods from about 1 second to about 60 seconds, depending on how much steam is generated and the amount of steam which can be handled within the plant setting. After the water is sprayed from the nozzles, it is evacuated back into a reservoir system for further use. The water is recycled many  
15 times, and cools the mold prior to the end result coming out of the mold.

FIG. 12 illustrates the resulting plastic molded article, with the paper-thin flashing extending around the perimeter of the mold where the seam has occurred, and it also shows the flat surface which can be achieved. The paper-thin flashing has been achieved due to the  
20 clamping arms which hold the mold together while the foaming is taking place. The clamping arms exert a very light pressure, on the order of from about 10mmHg to about 10,000mmHg, and this yields a superior product.

As shown in FIG. 13, the light clamping was not utilized during the process and  
25 consequently a heavier and larger flashing portion exuded from the mold seams when only gravity was used to hold the top mold against the bottom mold. Although this embodiment works equally as well, it is more economical to use less polyurethane foam powder if one clamps the molds together with a light pressure.

30 The resulting article made by the preferred embodiment of the process described herein includes two skins, one on one side and one on the other of the article, each being

approximately three millimeters in thickness. A one-inch thick foamed center is between the two skins, and the article may or may not be made with reinforcements therein. In the present example, a reinforcement of a fiberglass cloth was placed in the center of the plaque (the resulting plastic molded article) in order to impart strength. The previous patent applications  
5 which we have filed for 3DM Technologies, Inc., have incorporated descriptions of the possible reinforcements which may be utilized, and those applications are incorporated herein by reference.

Therefore, the present invention has been described in enough detail to enable one  
10 of ordinary skill in the art to reproduce the method and apparatus for forming plastic molded articles in a production line setting without undue experimentation. All of the objects and advantages listed first in this patent application are met and/or exceeded.

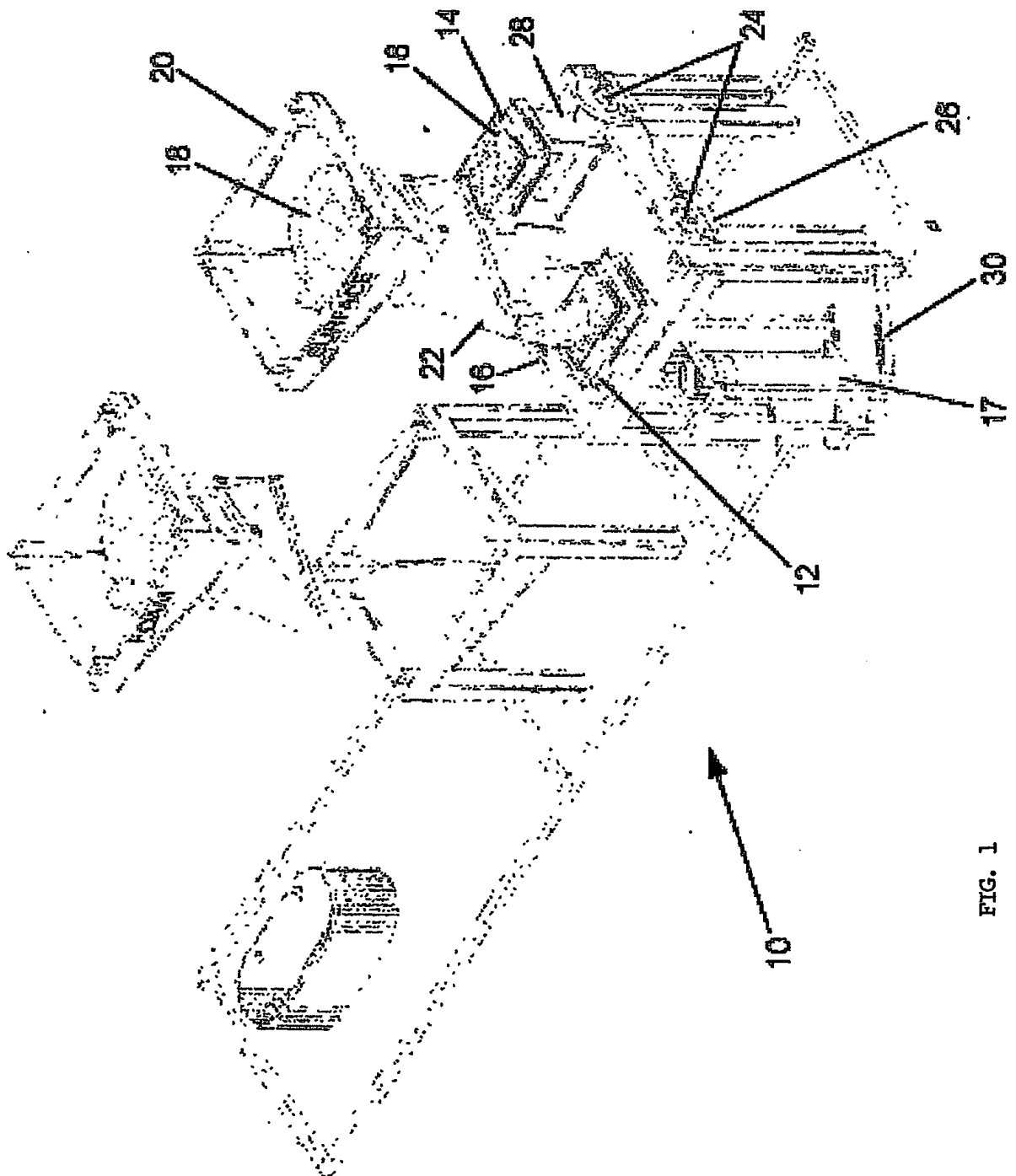


FIG. 1



FIG. 2

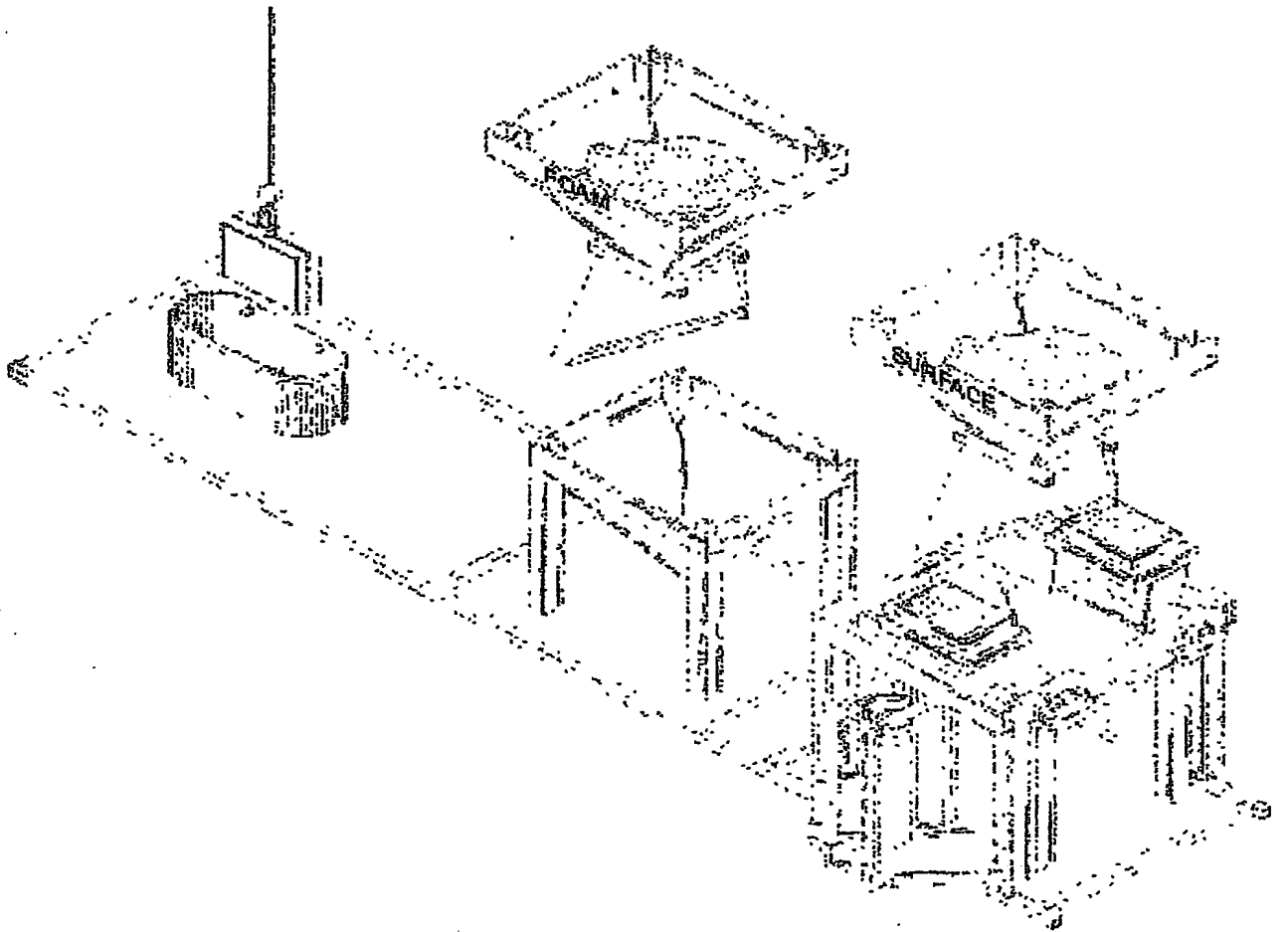
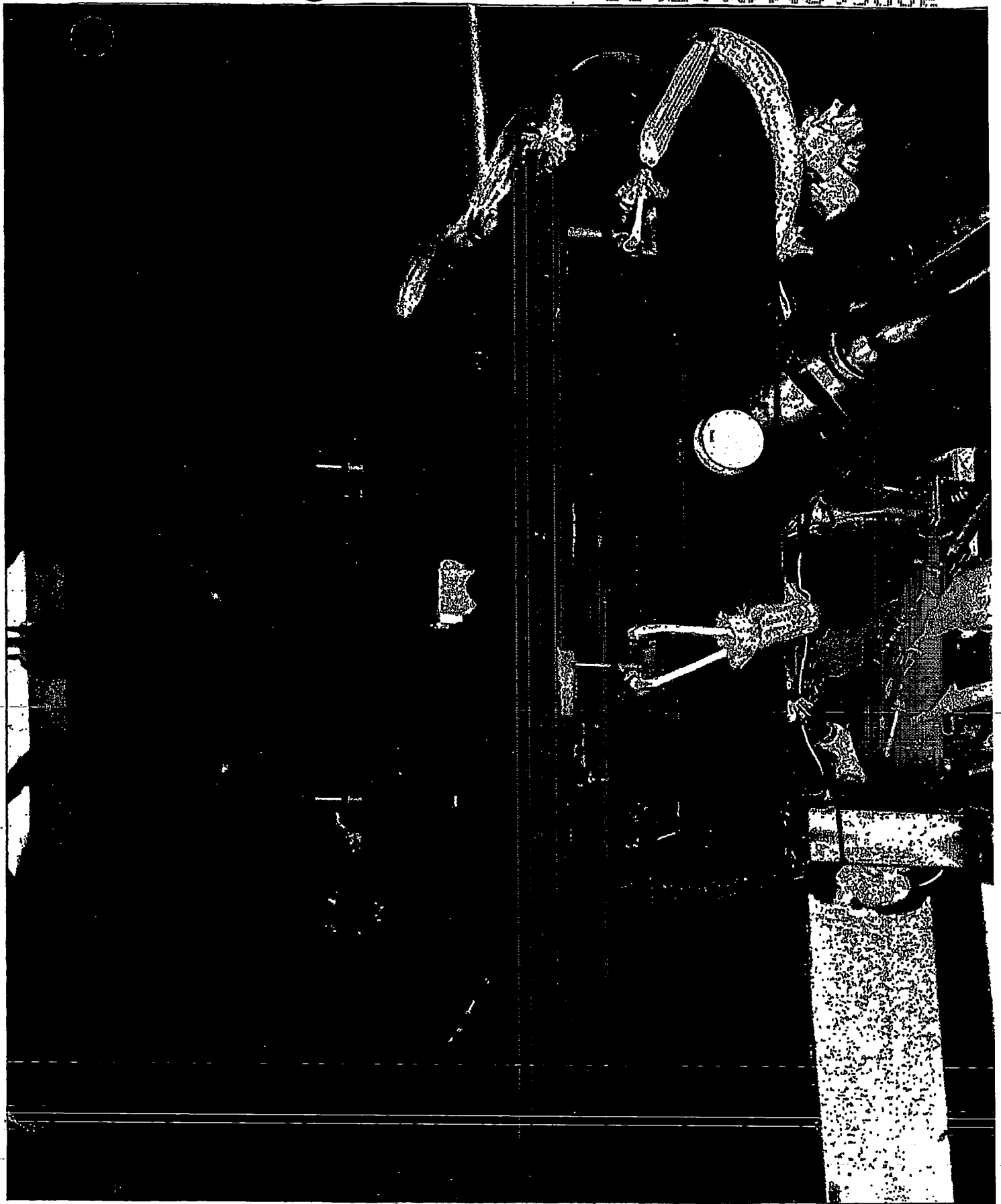
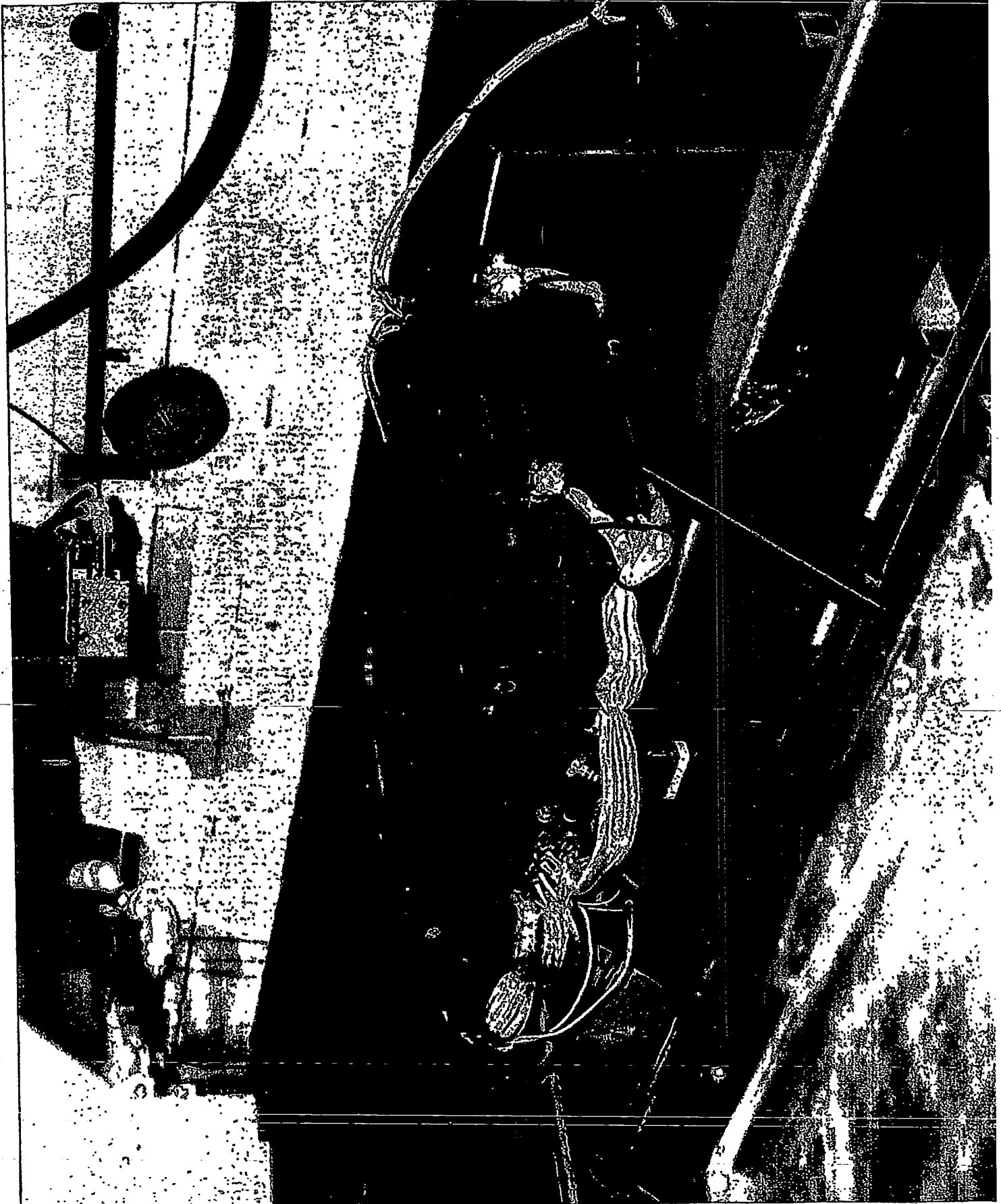


Fig. 3

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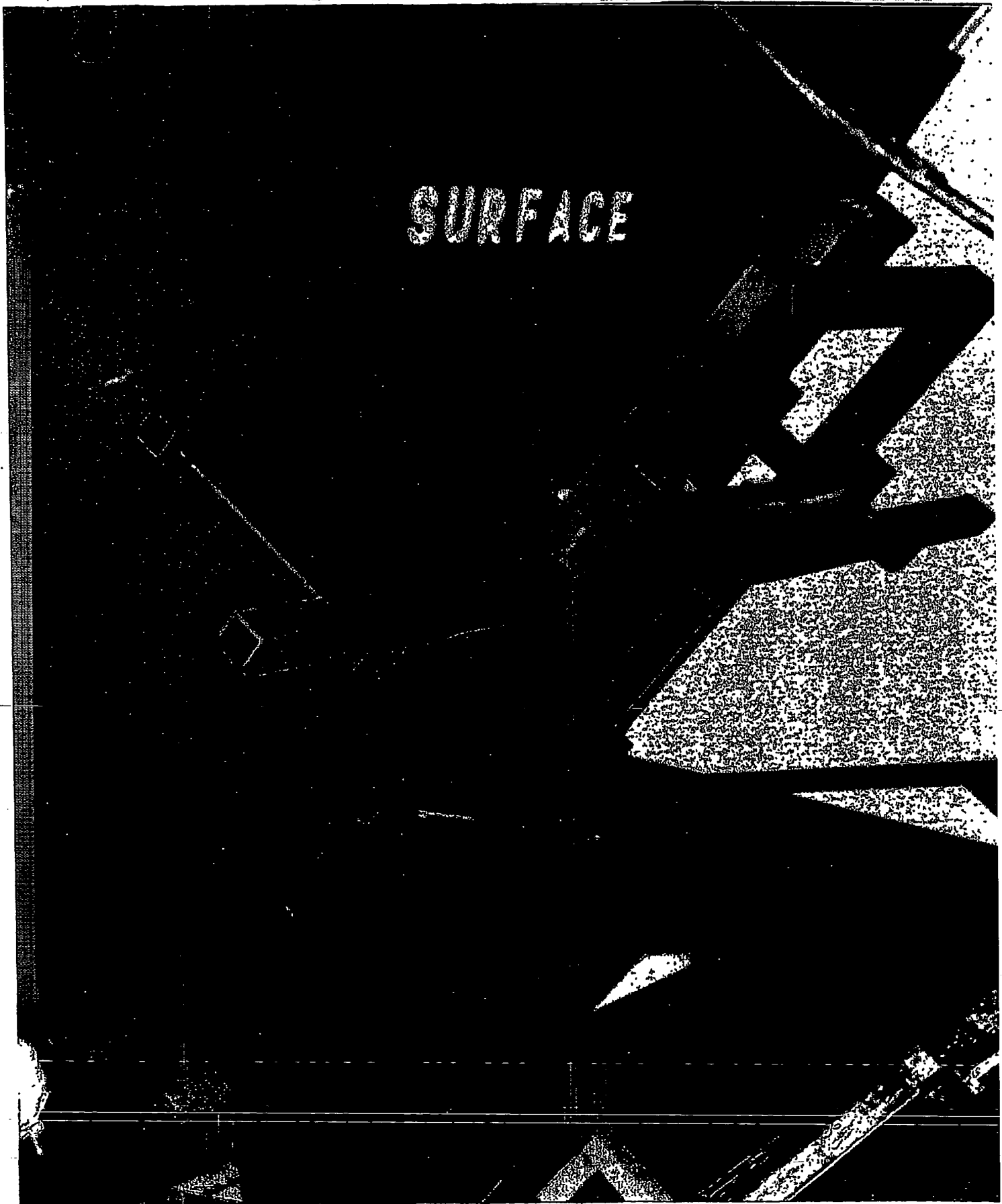
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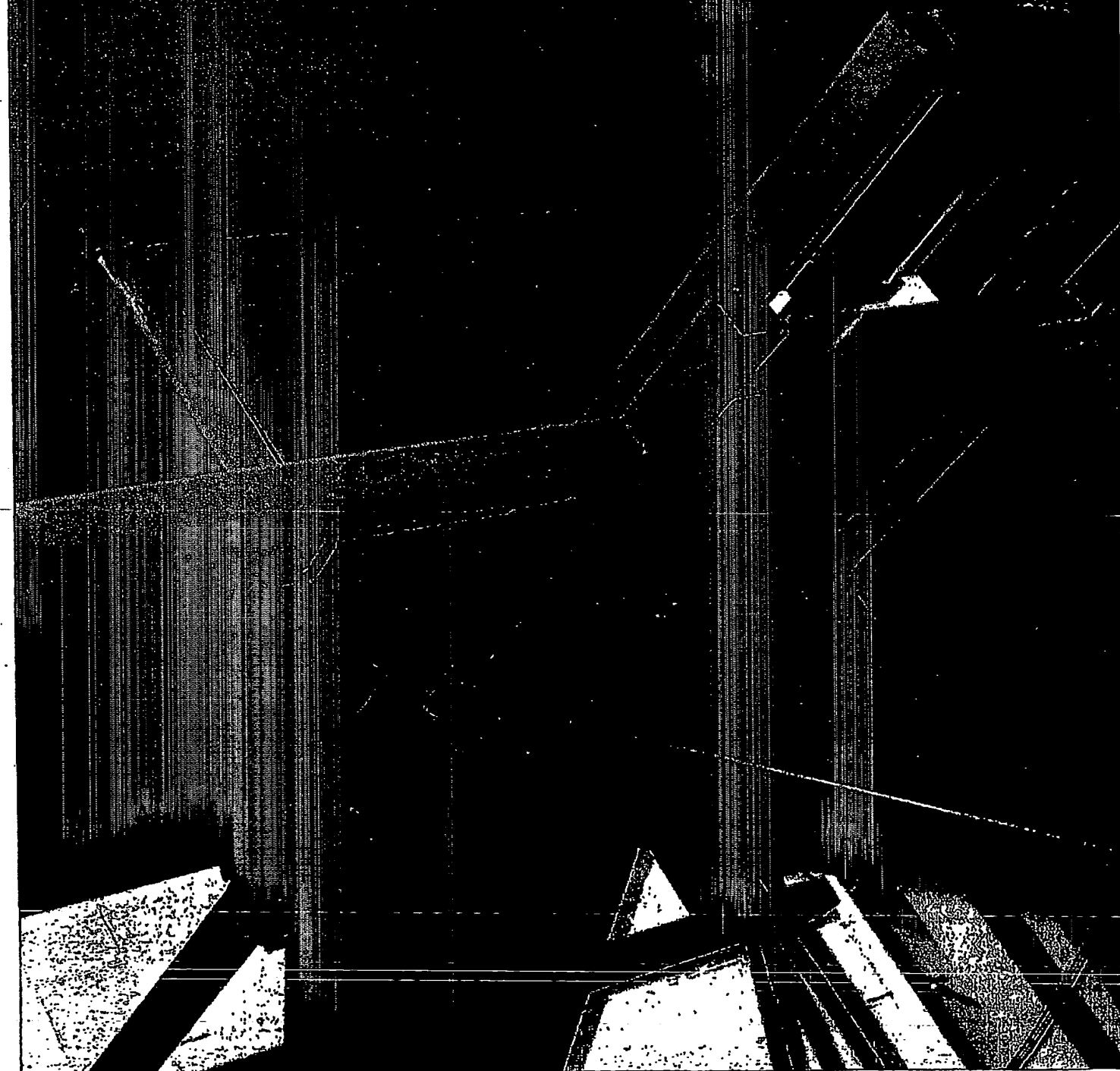


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SURFACE

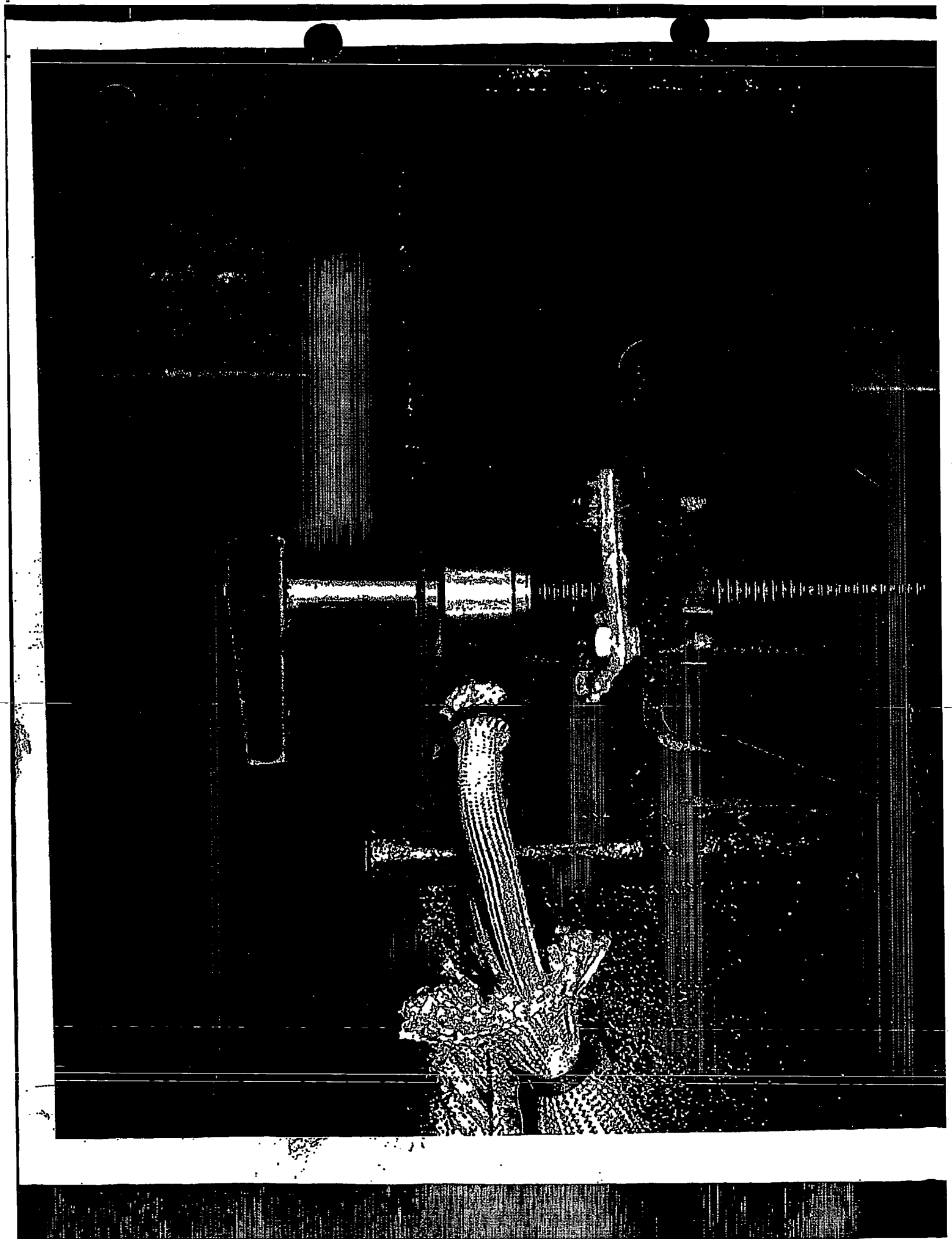


# FOAM

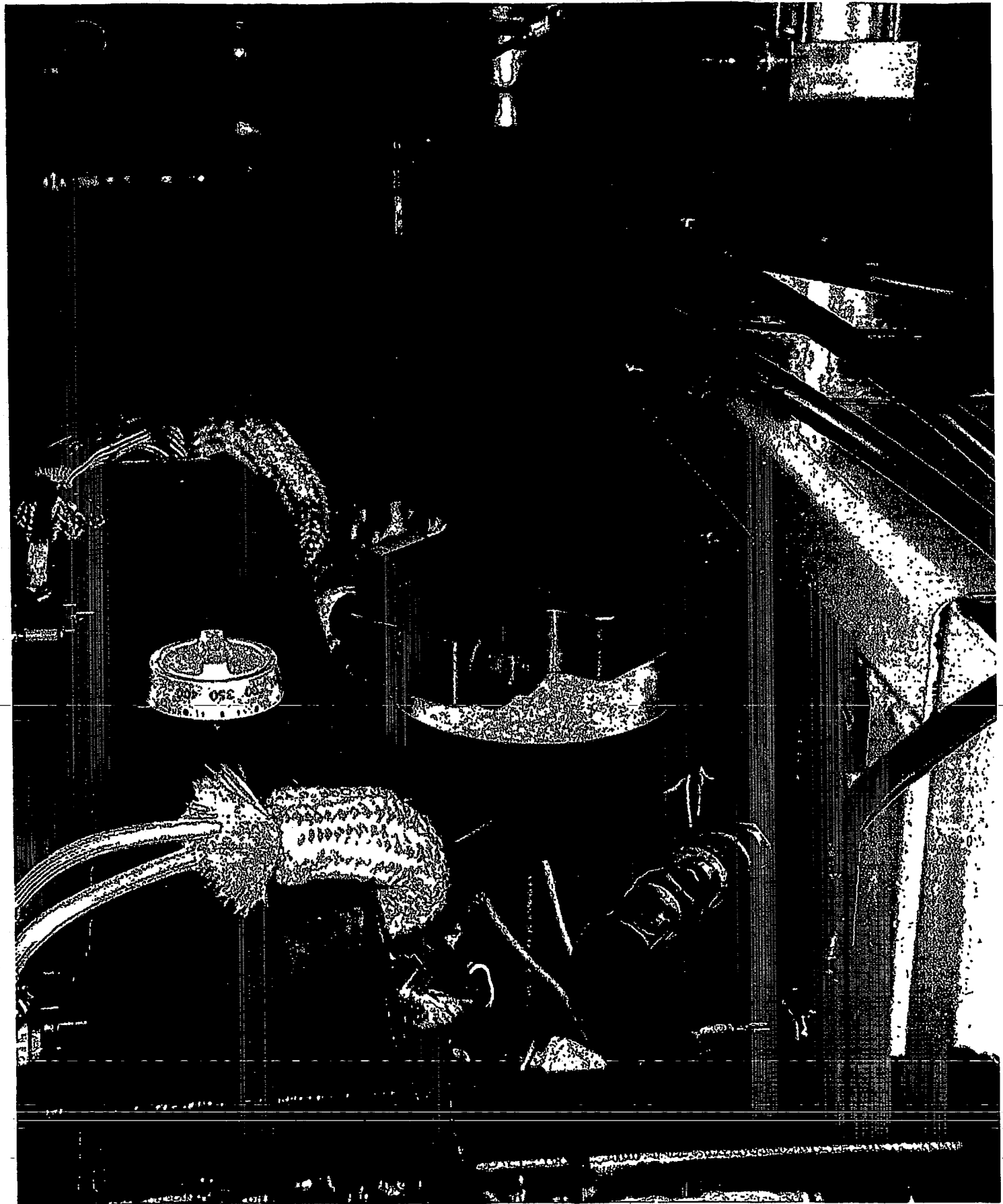


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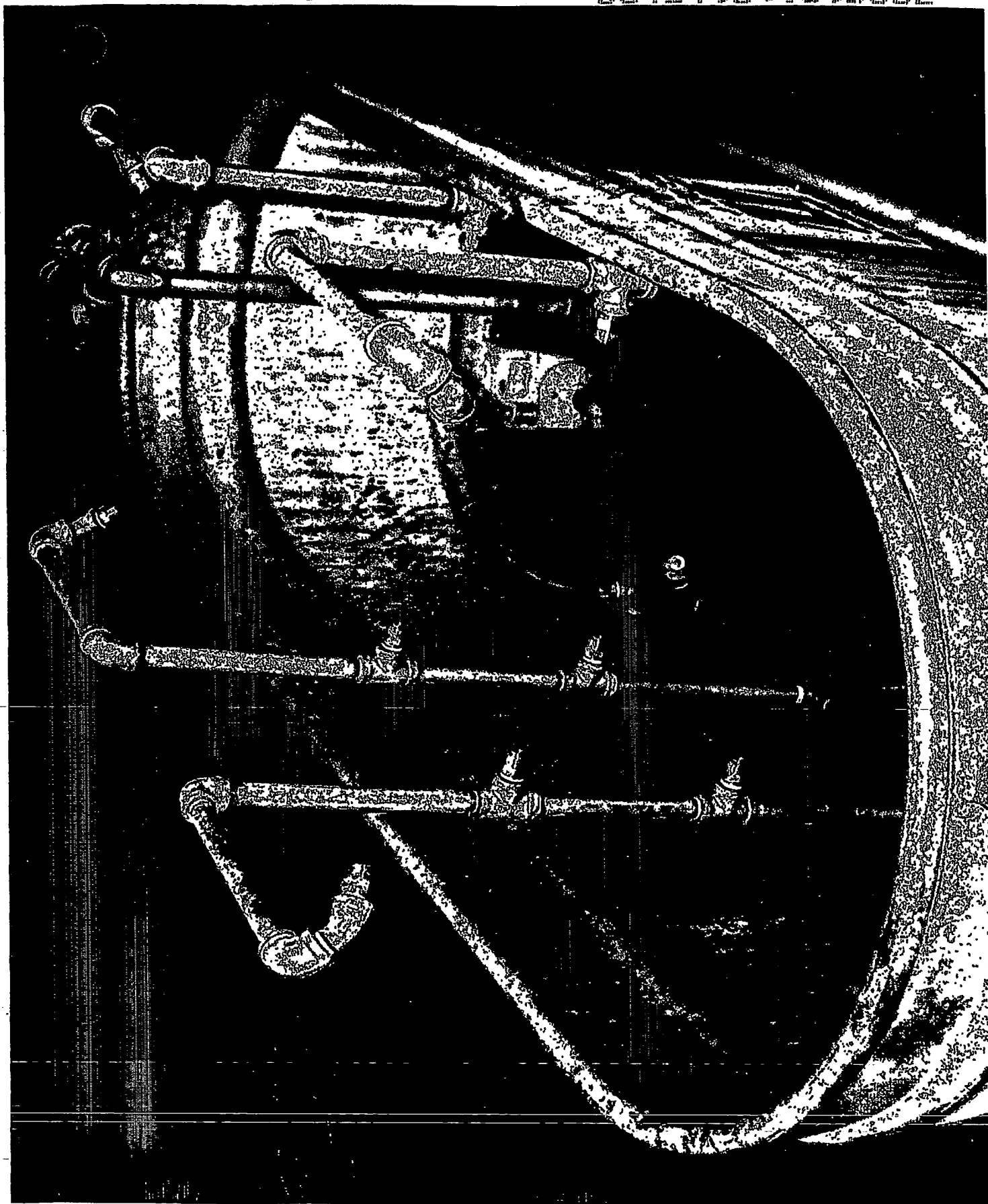




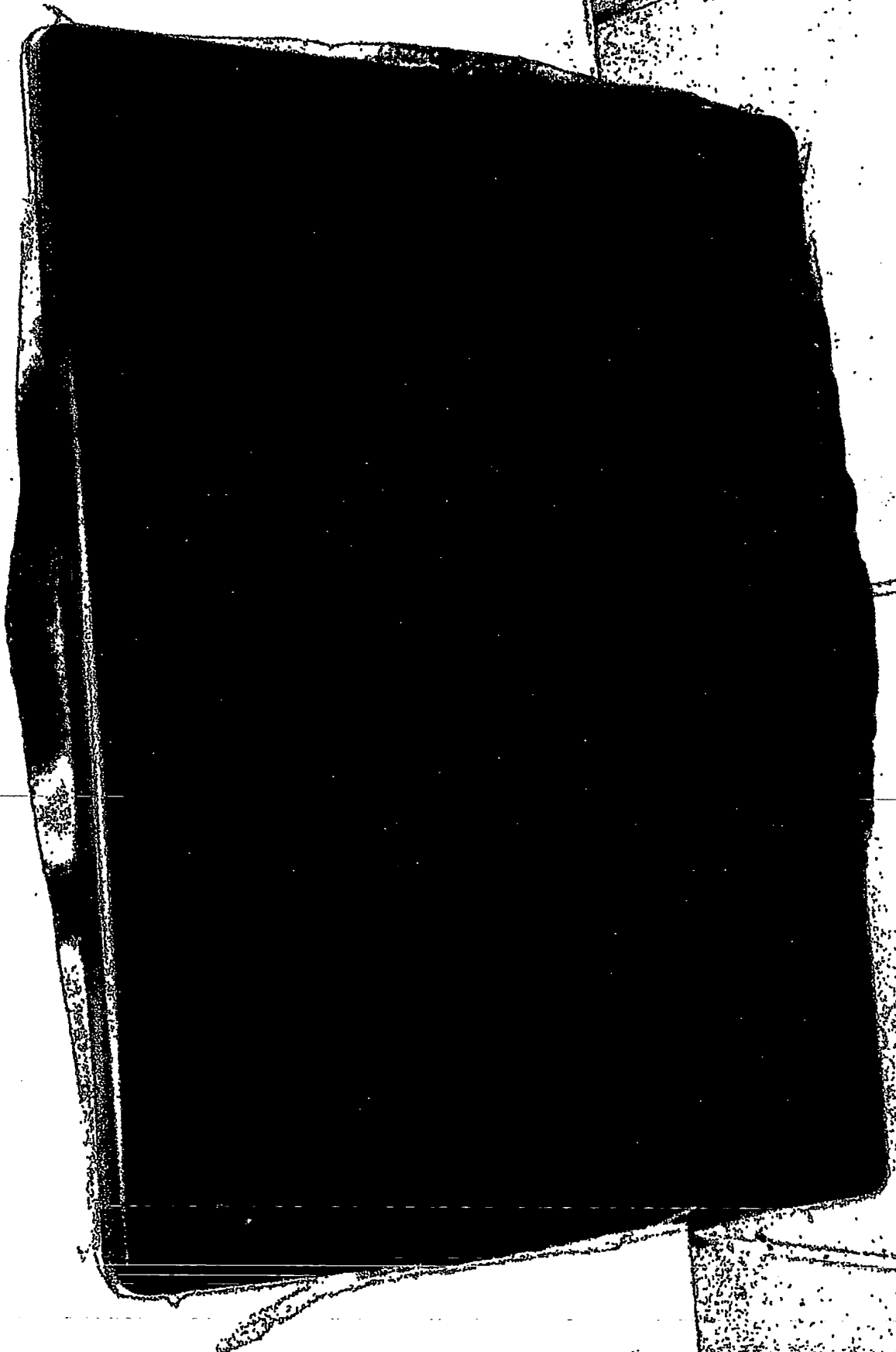
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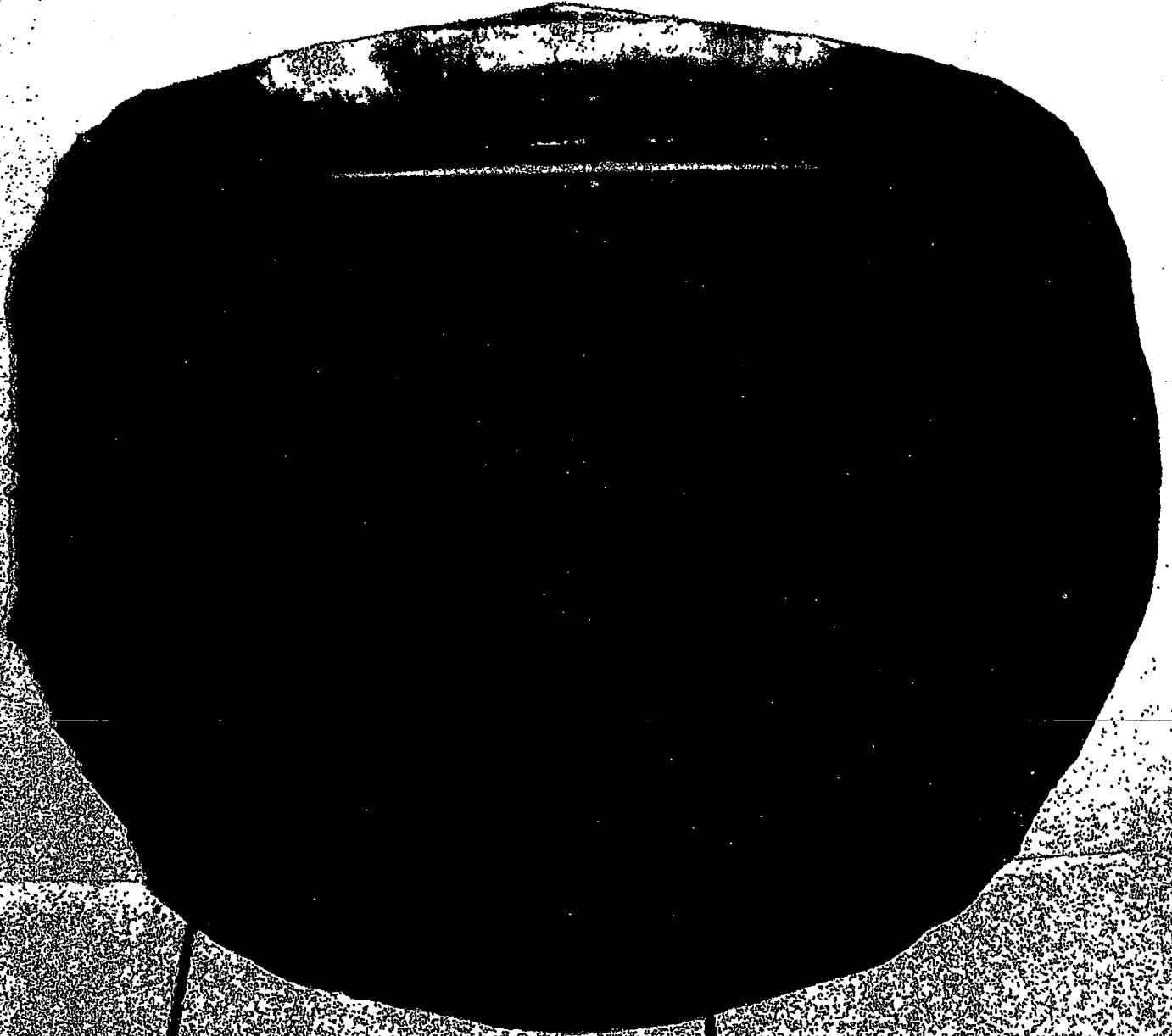
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